Natural large-scale regeneration of rib cartilage in a mouse model.

Journal: J Bone Miner Res

Publication Year: 2015

Authors: Marissa K Srour, Jennifer L Fogel, Kent T Yamaguchi, Aaron P Montgomery, Audrey K Izuhara, Aaron L Misakian, Stephanie Lam, Daniel L Lakeland, Mark M Urata, Janice S Lee, Francesca V Mariani

PubMed link: 25142306

Funding Grants: CIRM Stem Cell Biology Training Program

Public Summary:
No effective clinical approach to healing patients with large cartilage lesions currently exists. One way to make new headway is to study regeneration when it occurs naturally. Cartilage repair is typically slow and incomplete. However, an exception to this observation can be found in the costal cartilages, where complete repair has been reported in humans but the cellular and molecular mechanisms have not yet been characterized. In this study, we establish a novel animal model for cartilage repair by creating full-thickness lesions in the mouse rib costal cartilage. Our results show that full replacement of the cartilage occurs quickly (within 1 to 2 months) and that the surrounding connective tissue houses the cartilage precursors involved. We conclude that we have successfully established a new model for large-scale hyaline cartilage repair which should be useful for gaining a more detailed understanding of cartilage regeneration and ultimately for developing methods to improve cartilage and bone repair in other parts of the skeleton.

Scientific Abstract:
The clinical need for methods to repair and regenerate large cartilage and bone lesions persists. One way to make new headway is to study skeletal regeneration when it occurs naturally. Cartilage repair is typically slow and incomplete. However, an exception to this observation can be found in the costal cartilages, where complete repair has been reported in humans but the cellular and molecular mechanisms have not yet been characterized. In this study, we establish a novel animal model for cartilage repair using the mouse rib costal cartilage. We then use this model to test the hypothesis that the perichondrium, the dense connective tissue that surrounds the cartilage, is a tissue essential for repair. Our results show that full replacement of the resected cartilage occurs quickly (within 1 to 2 months) and properly differentiates but that repair occurs only in the presence of the perichondrium. We then provide evidence that the rib perichondrium contains a special niche that houses chondrogenic progenitors that possess qualities particularly suited for mediating repair. Label-retaining cells can be found within the perichondrium that can give rise to new chondrocytes. Furthermore, the perichondrium proliferates and thickens during the healing period and when ectopically placed can generate new cartilage. In conclusion, we have successfully established a model for hyaline cartilage repair in the mouse rib, which should be useful for gaining a more detailed understanding of cartilage regeneration and ultimately for developing methods to improve cartilage and bone repair in other parts of the skeleton.